Amendments to the Claims

Claims Listing

1. (currently amended) A numerically controlled method of moving an object to be controlled along a predetermined locus, by controlling respective control axes in a joint space, said method comprising:

approximating said locus by defining a spatial polynomial in a work space, said spatial polynomial having a parameter λ which is not dependent on time;

converting ~~a~~ parameter λ of said spatial polynomial~~, which is not dependent on time,~~ to insert a time variable t function, thereby obtaining a time parameter polynomial defining position as a function of time;

producing a position command, a velocity command and an acceleration command from said converted time parameter polynomial;

converting and delivering said produced position command, said velocity command and said acceleration command ~~applying said time parameter polynomial~~ to said respective control axes in said joint space, ~~including distributing said time parameter polynomial over each said control axis;~~

producing control commands for said respective control axes in said joint space from said position command, said velocity command, and said acceleration command on the basis of said time parameter polynomial, converted and distributed ~~as applied~~ to said control axes in said joint space; and

moving said object to be controlled along said locus, while controlling said respective control axes in said joint space on the basis of said control commands.

2. (currently amended) The numerically controlled method as set forth in claim 1 wherein said control command is produced partly on the basis of said ~~a~~ position command on displacement at a given time from said time parameter polynomial, said ~~a~~ velocity command obtained from a first derivative of said time parameter ~~type~~ polynomial, and said ~~an~~ acceleration command obtained from a second derivative of said time parameter ~~type~~ polynomial.

3. (currently amended) The numerically controlled method as set forth in claim 1 wherein said control command is executed by computing a position and velocity at ~~the~~ a time in future, wherein when said control command is executed, said object to be controlled has not yet moved on the basis of said time parameter ~~type~~ polynomial.

4. (currently amended) A method for controlling an object in a work space, the object being positionable in the work space by controls operable to position the object in plural control axes, comprising:

defining a spatial locus of the object including a line in the work space, wherein the line is approximated by a spatial polynomial having displacement variables, the spatial polynomial representing the line by spatial variables independent of time;

applying a time function to at least one said spatial variable, and converting said spatial polynomial to a motion polynomial by replacing said spatial variable with the time function, the motion polynomial having spatial variables as a function of time;

producing a position command, a velocity command and an acceleration command from said converted motion polynomial;

converting and distributing motions defined by the motion polynomial over the plural control axes, each of the control axes having a corresponding axis motion as a function of time; and

controlling the plural control axes according to said position command, said velocity command, and said acceleration command ~~a respective said corresponding axis motion~~.

5. (previously presented) The method of claim 4, wherein the plural axes are controlled by feedback control loops responsive to displacement of the object and also to at least one of velocity, acceleration and jerk of the object, and wherein the control loops are at least partly responsive to a value of said at least one of velocity, acceleration and jerk derived mathematically from the motion polynomial.

6. (previously presented) The method of claim 5, further comprising differentiating the motion polynomial at least once to define a control input to a control loop of one of the plural axes.

7. (previously presented) The method of claim 6, comprising predicting at least one of a velocity, acceleration and jerk at a future point in time during control of said one of the plural axes.

8. (new) The numerically controlled method as set forth in claim 1, wherein when converting said parameter λ of said spatial polynomial, which is not dependent on time, to insert a time variable t function in order to obtain a time parameter polynomial, said parameter λ is obtained as a function of time t supposing that a length of one of many line elements obtained by dividing a curved line represented by said polynomial having said parameter λ, which is not dependent on time, into many numbers is equal to a movement distance of moving within a predetermined time on the basis of a speed function F(t) having a parameter of time t, and said time parameter polynomial is produced on the basis of $\lambda=\alpha(t)$ thus obtained.